Three Phosphorus TMDLs for
Lockatong Creek
and
Wickecheoke Creek
Watersheds

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Division of Watershed Management
Bureau of Environmental Analysis and Restoration

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Overview of Presentation

- What is a TMDL
- Flow Integrated Reduction Methodology
- TMDL Calculations for Impaired Segments
- TMDL Implementation Measures
- Summary

What are TMDLs?

- Total Maximum Daily Loads (TMDLs) represent the assimilative or load capacity of the receiving water, taking into consideration:
    - point sources of pollutants (wasteload)
    - nonpoint sources of pollutants (load)
    - natural background
    - surface water withdrawals

2004 Integrated List

SUBLIST 1 & 2: FULL ATTAINMENT

LIMITED ATTAINMENT DATA

SUBLIST 3: INSUFFICIENT DATA TO ASSESS

SUBLIST 4: IMPAIRED BUT:

TMDL Completed

IMPAIRMENT BY POLLUTION NOT POLLUTANT

OTHER ENFORCEABLE MEASURES WILL ADDRESS

SUBLIST 5: NON-ATTAINMENT } 303(d) List

Establish & Implement TMDLs

- Establish TMDL in accordance with MOA schedule with EPA:
  - Propose TMDL as an amendment to water quality management plans (WQMPs)
  - Establish TMDL - submit to EPA for formal approval
  - Adopt TMDL as amendment to WQMP

- Implementation of Control Actions:
  - Issue water quality-based permits
  - Additional Measures per Phase 2 Stormwater Permits
  - Implement nonpoint source controls through funding from NJDEP as it is available (319H & CBT)

How are **TMDLs** expressed?

Amount of pollutants that a waterbody can assimilate without violating surface water quality standards or other target

$$\textbf{TMDL} = \sum \textbf{WLA} + \sum \textbf{LA} + \textbf{MOS}$$

Where:

WLA is the wasteload allocation

LA is the load allocation and

MOS is the margin of safety

Margin of Safety (MOS)

- A required component of the TMDL that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality (40 CFR 130.79(c))

- The MOS shall be expressed either as an internal modeling factor and/or as an explicit, separate factor (N.J.A.C. 7:15- 7.7(a))

Components of TMDL Document

- Source assessment
  - characterization and quantification as necessary
  - identify point, nonpoint and background sources
- Water quality analysis
  - link pollutant sources & water quality: model
  - consider seasonal variation / critical conditions

- TMDL calculations
  - loading capacity
  - margin of safety
  - load and wasteload allocations
- Follow-up monitoring
- Implementation
- Public participation

Target for TMDL: SWQS for Phosphorus (mg/L)

Numerical Criteria

- i.   **Lakes**: TP not to exceed **0.05** in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where site-specific criteria are developed (N.J.A.C. 7:9B-1.5(g)3)

- ii.   **Streams**: TP not to exceed **0.1** in any stream, unless it can be demonstrated that TP is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

SWQS for Phosphorus (mg/L), continued

**Narrative Criteria--Nutrient policies are as follows:**

- Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

TMDL Model Used: Flow-Integrated Reduction of Exceedances (FIRE)

- Method must be selected to relate water quality to pollutant loading

- FIRE uses site-specific water quality concentration and flow data to determine the relationship between flow and load. The required reduction was calculated by comparing the site-specific relationship to the target relationship, which corresponds to attainment of the New Jersey Surface Water Standards.

Illustrative Example of FIRE

Flow-Integrated Water Quality Exceedance Assessment
(Hypothetical Total Phosphorus Data)
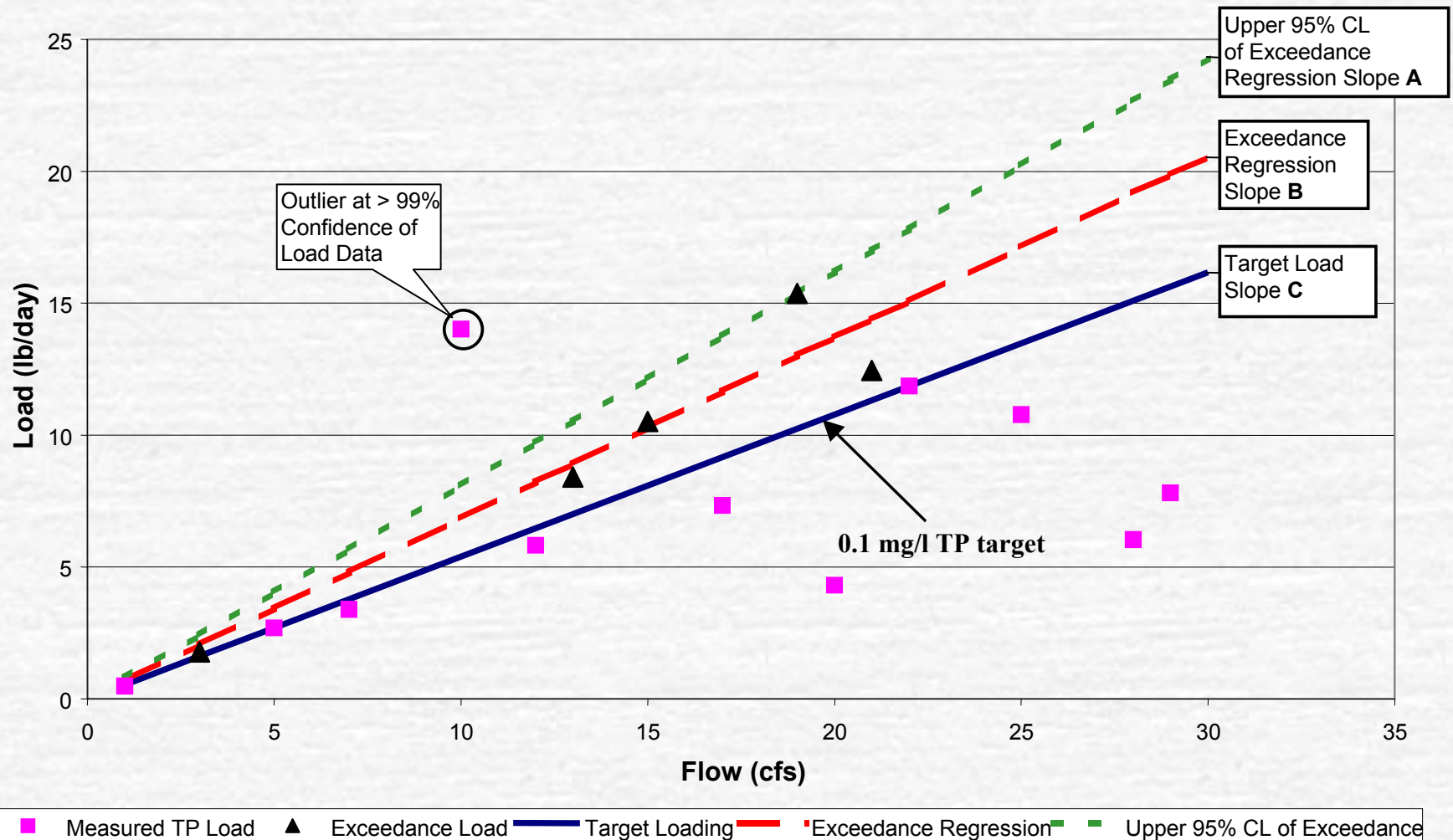
Load Capacity

- The Load Capacity of the waterbody is calculated by comparing the Exceedance Regression line to the Target Loading line, including a Margin Of Safety (MOS)

- MOS is derived from the difference between the slopes of the Upper 95 percent confidence limit of the Exceedance Regression and the Exceedance Regression line and becomes an unallocated portion of the Load Capacity

Load Reduction

- The Overall required Load Reduction is calculated based on the difference between the slopes of the Upper 95 percent confidence limit of the Exceedance Regression and the Target Loading lines.

Load Allocation

- Existing load is calculated by applying loading (or export) coefficients, which represent annual average loads from various land uses, to the areal extent of each land use in the drainage area, determined using GIS

- WLAs and LAs are then derived from the allocable load, with LA reductions taken only from land uses where reductions are feasible

- No reduction is taken from forest, wetland, water and barren land uses; these load contributions remain unchanged between existing and future scenarios

TMDL Calculations

- **Load Capacity (Target Load)**

  = (Slope C ÷ Slope B) x 100 = % of existing loadings

- **Total Overall Loading Reduction**

  = [1 − (Slope C ÷ Slope A)] x 100

  = % of existing loadings

- **Margin of Safety**

  = [1 − (Slope B ÷ Slope A)] x 100

  = % of Load Capacity

- **Percent Reduction of Adjustable Land-Use Loads**

  = [1 - (Load Capacity – MOS – Non-Adjustable Land-Use Loads) ÷ (Total Existing Loads – Non-Adjustable Land-Use Loads)] x 100

  = % of existing adjustable land-use loads

I
**compare Slope
C to Slope B**

X$_I$
(1-C/B)

Y$_I$
(C/B)

II
**compare Slope
C to Slope A**

X$_{II}$
(1-C/A)

Y$_{II}$
(C/A)

MoS

AL

Existing Load

Overall Load Reduction
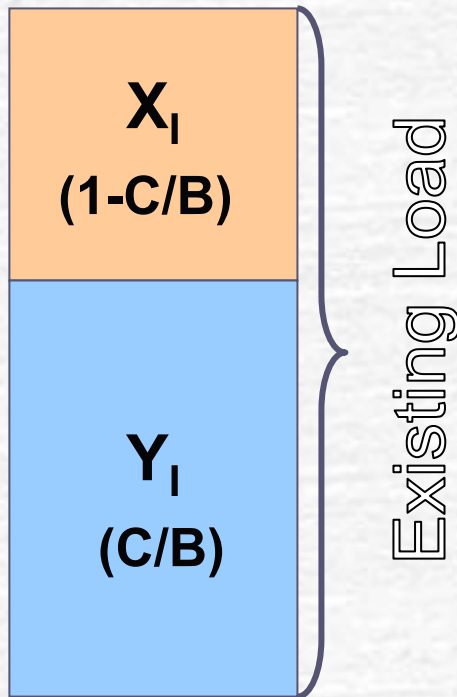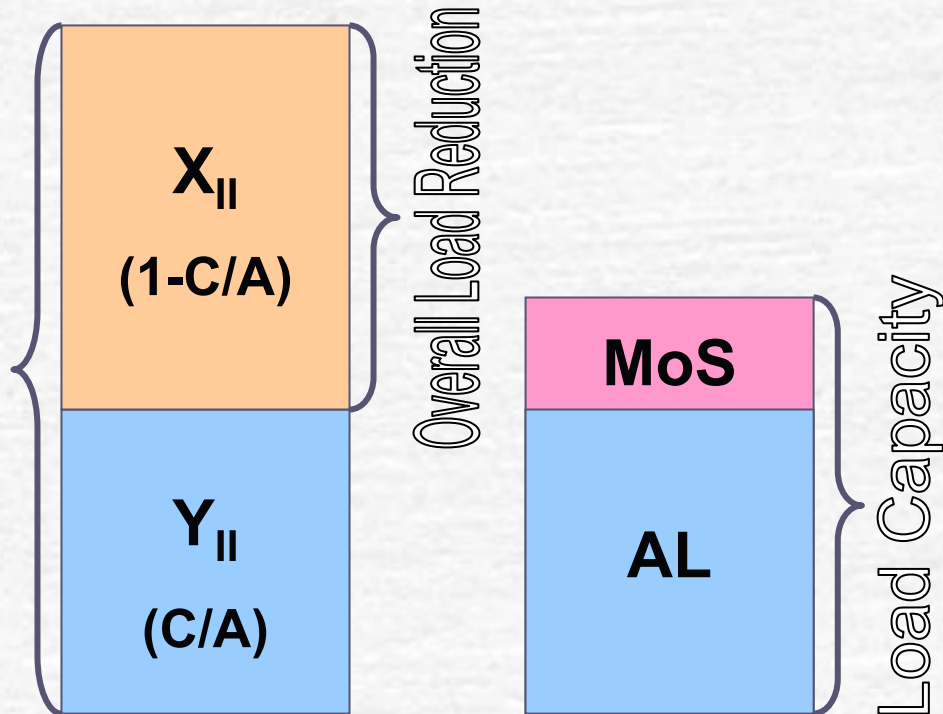
Load Capacity

X= load to be reduced;

Load Capacity = Y$_I$;

MOS (Margin of Safety) = Y$_I$-Y$_{II}$

Y= existing load – X

AL (Allocable Loading) = Y$_{II}$;

UAL Methodology

Pollutant Export Coefficients obtained from literature sources are applied to land use patterns:

- Land Use determined by NJDEP's 1995/97 GIS Coverage.

- Phosphorus export coefficients selected for NJ from an extensive database to develop table on next slide.
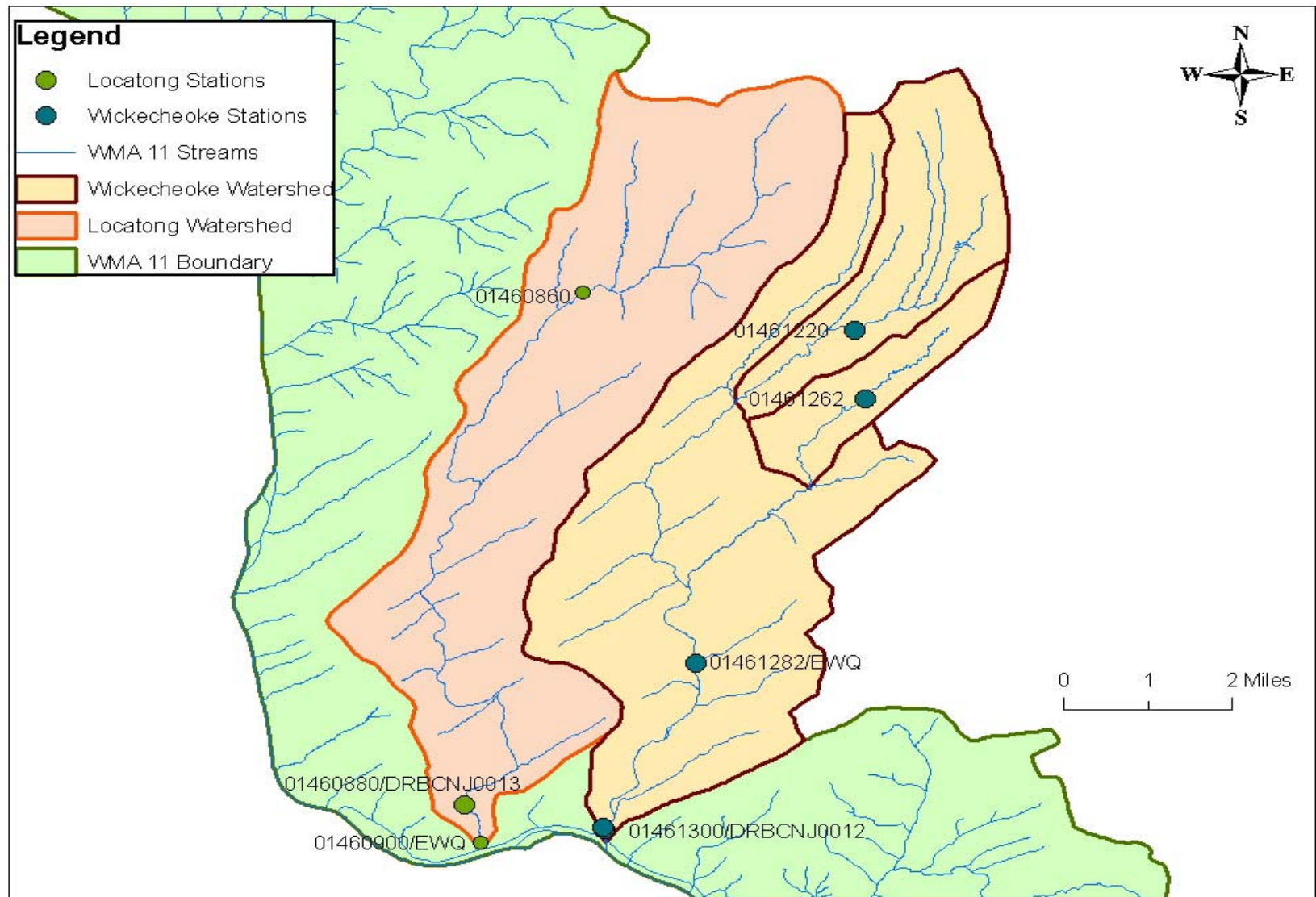
Phosphorus export coefficients
(Unit Areal Loads)

land use / land cover	LU/LC codes	UAL (kg TP/ha/yr)
Mixed density residential	1100	1.2
medium / high density residential	1110, 1120, 1150	1.6
low density / rural residential	1130, 1140	0.7
Commercial	1200	2.0
Industrial	1300, 1500	1.7
mixed urban / other urban	other urban codes	1.0
Agricultural	2000	1.5
forest, wetland, water	1750, 1850, 2140, 2150, 4000, 5000, 6000, 7430, 8000	0.1
barren land	7000	0.5
Units:	1 hectare (ha) = 2.47 acres 1 kilogram (kg) = 2.2 pounds (lbs) 1 kg/ha/yr = 0.89 lbs/acre/yr	

Phosphorus Impaired Segments
from 2004 Integrated Report
WMA11

| Sublist	Station Name/Waterbody	Site ID	Data Source	Management Response	Stream Miles
5	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	DRBC	TMDL	14.55
3	Plum Brook near Locktown	01461262	NJDEP/USGS Data	Insufficient data	3.37
3	Wickecheoke Creek at Croton	01461220	NJDEP/USGS Data	Insufficient data	10.10
3	Wickecheoke Creek near Sergeantsville	01461282 (EWQ)	NJDEP/USGS Data	TMDL	18.50
5	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	NJDEP/USGS Data, DRBC	TMDL	5.47
Total River Miles					38.52 (51.99)

Land Uses for Lockatong and Wickecheoke Creeks

Legend

LAND USES
- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN
- WATER
- WETLANDS
- Lockatong Impaired Drainage
- Wickecheoke Impaired Drainage

0 0.5 1   2 Miles
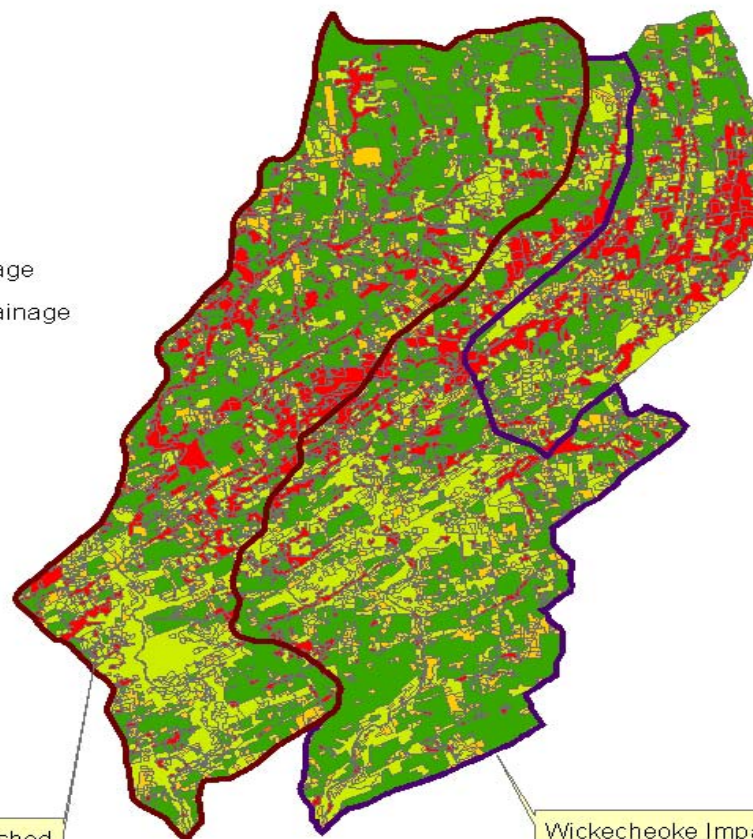
Locatong Impaired Watershed

Wickecheoke Impaired Watershed

Summary of Data

- Phosphorus concentration: >10% results exceeded SWQS of 0.1 mg/L TP

- Lockatong; DRBCNJ0013, 4 of 34 results (11.8%)

- Wickecheoke; 01461282, 2 of 16 results (12.5%)

- Wickecheoke; DRBCNJ0012/01461300, 10 of 95 results (10.5%)

- Phosphorus could not be excluded as a limiting nutrient

- TMDL is Required

Summary of FIRE Application

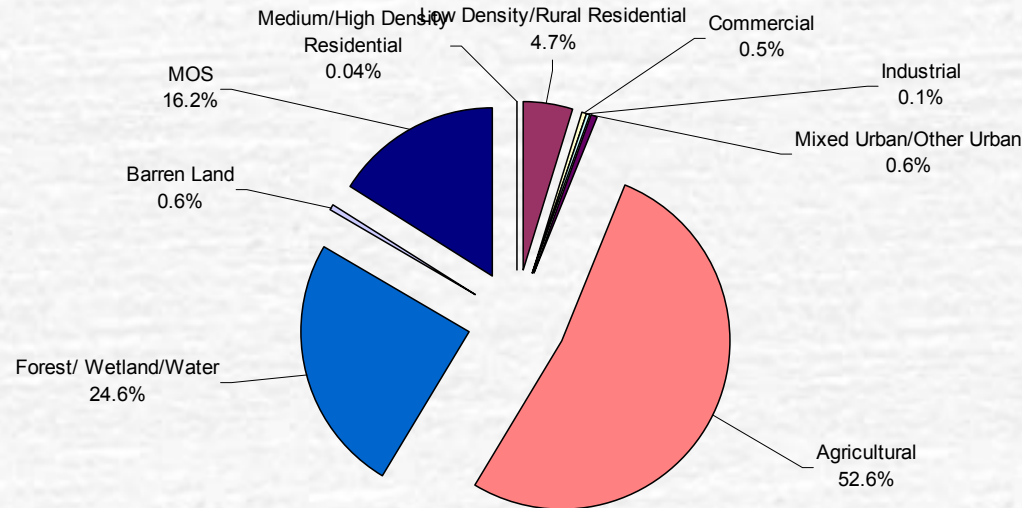| TMDL	Lockatong Creek Watershed	Wickecheoke Creek Watershed
Derived from FIRE Method:		
Slope A	3.0686	1.1245
Slope B	2.5717	0.8644
Slope C (SWQS at 0.1 mg/L)	0.5390	
Derived from Export Coefficients: (kg/year)		
Total Existing Loading	5,317	5,464
Non-Adjustable Loading	281	324
Loading capacity (TP not to exceed 0.1 mg/L)	1,114	3,409
Margin of Safety (Percent of Loading Capacity)	180 (16.5%)	788 (23.1%)
Overall Load Reduction Required (including MOS)	82 %	52%
Adjustable Load Reduction Required	86.9%	56%

TMDL Calculations for Lockatong Creek Watershed

	Lockatong Creek		% reduction
	kg TP/yr	% of LC	
Loading capacity (LC)	**1114**	**100%**	**n/a**
Load allocation			
Point Sources other than Stormwater	n/a		
Nonpoint and Stormwater Sources			
medium / high density residential	0.4507	0.04	86.9
low density / rural residential	52.67	4.7	86.9
commercial	5.764	0.5	86.9
industrial	1.596	0.1	86.9
mixed urban / other urban	6.635	0.6	86.9
agricultural	585.7	52.6	86.9
forest, wetland, water	274.4	24.6	0%
barren land	6.699	0.6	0%
Margin of Safety	180.5	16.2	n/a

Phosphorus Load Allocations for Lockatong Creek Watershed

Station DRBC0013/01460880

Load Capacity = 1114 kg/year

Pie chart of phosphorus load allocations:
- Agricultural 52.6%
- Forest/Wetland/Water 24.6%
- MOS 16.2%
- Low Density/Rural Residential 4.7%
- Mixed Urban/Other Urban 0.6%
- Barren Land 0.6%
- Commercial 0.5%
- Industrial 0.1%
- Medium/High Density Residential 0.04%

TMDL Calculations for Wickecheoke Creek Watershed

	Wickecheoke Creek		% reduction
	kg TP/yr	% of LC	
Loading capacity (LC)	**3409**	**100%**	n/a
Load allocation			
Point Sources other than Stormwater			
Delaware Twp MUA	44.96	1.3	n/a
Nonpoint and Stormwater Sources			
medium / high density residential	6.344	0.2	56
low density / rural residential	192.5	5.6	56
commercial	14.60	0.4	56
industrial	5.672	0.2	56
mixed urban / other urban	29.33	0.9	56
agricultural	2004	58.8	56
forest, wetland, water	309.6	9.1	0
barren land	14.68	0.4	0
Margin of Safety	787.6	23.1	na

Phosphorus Load Allocations for Wickecheoke Creek Watershed

Station 01461300/DRBC0012

Load Capacity = 3409 kg/year
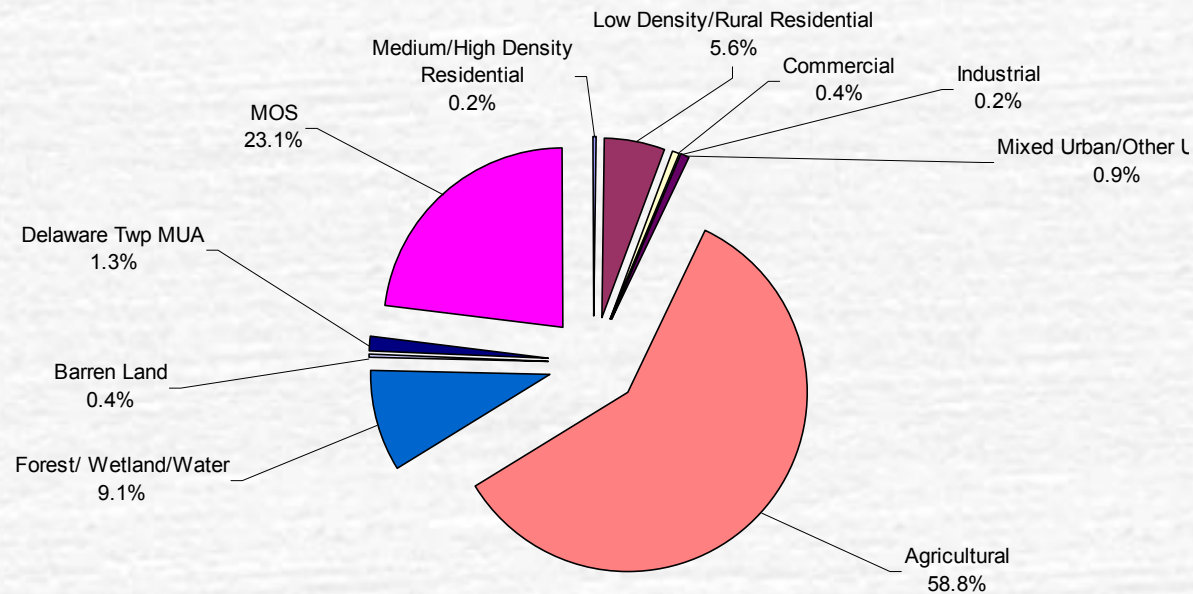
TMDL Implementation
(Point Sources)

- For TMDL purposes, point sources include discharges to surface water that are subject to regulation under the Clean Water Act, National Pollutant Discharge Elimination System.

- Point source reductions are accomplished through NJPDES permits: effluent limits or Phase II stormwater basic requirements, as well as additional measures, if appropriate.

TMDL Implementation
(Non-Point Sources)

- For TMDL purposes, nonpoint sources are those that are not subject to regulation under NPDES, including NJPDES Tier B municipal stormwater discharges

- Nonpoint source reductions are achieved through implementation of management measures that can reduce loads, e.g. land use BMPs, NJPDES basic requirements and additional measures applied to Tier B municipal stormwater dischargers, etc.

Resources for Implementation

- Agricultural BMPs: EQIP, CRP, CREP
- 319(h) grants for nonpoint source projects
- Environmental Infrastructure Financing Program loans
- Estuary Programs
- Private grant programs

Conclusion

All TMDL documents are posted at

www.state.nj.us/dep/

Watershedmgt/tmdl.htm

Conclusion

- All TMDL documents are available for download at www.state.nj.us/dep/watershedmgt/tmdl.htm

- Comments are due within 15 days from the date of the public hearing (closing date August 23, 2005) to:

Barbara Hirst, Bureau Chief

NJDEP – DWM

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